IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appln No.:	10/035,027	Confirmation No. 9194
Applicants:	Xiangyang Zhuang et al.	
Filed:	December 28, 2001	
For:	DATA TRANSMISSION AND RECEPTION METHOD AND APPARATUS AND METHOD	This Appeal Brief was electronically filed using the USPTO's EFS-Web.
TC/A.U.:	2664	
Examiner:	Chuong T. Ho	
Docket No.:	CR00311M (72463)	
Customer No.:	22242	

APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Pursuant to 37 C.F.R. §1.192, the applicants hereby respectfully submit the following Brief in support of their appeal.

(1) Real Party in Interest

The real party in interest is Motorola, Inc., a Delaware corporation having a primary place of business in Schaumburg, Illinois.

(2) Related Appeals and Interferences

There are no related appeals or interferences known to appellant, the appellant's legal representative, or assignee that will directly affect, or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

Claims 1-8 and 10-18 are pending and presently stand finally rejected and constitute the subject matter of this appeal. Claims 9, 20, 21, and 24-27 have been withdrawn from consideration. Claims 19, 22, 23, 28, and 29 are allowed.

(4) Status of Amendments

One post-final amendment, to submit corrected formal drawings, has been submitted contemporaneously with this Appeal Brief. The status of that amendment is unknown.

(5) Summary of Claimed Subject Matter

The invention relates generally to a method of transmitting data. As shown in FIG. 1 and FIG. 2 from the patent application, this begins with provision (11) of a data stream of bits.[1] This can comprise a stream of information from a single source or can, if desired, comprise an

1 Specification at page 3, line 27.

aggregation of data as is provided by a plurality of sources (as illustrated in FIG. 2).[2] This can comprise receiving such a data stream (or data streams) at, for example, a coder (21).

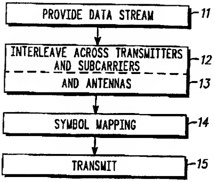


FIG. 1

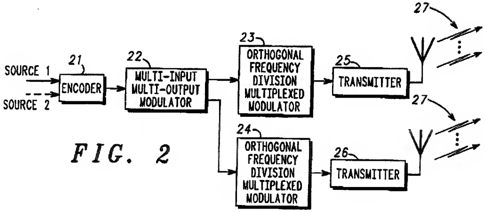


FIG. 2

The bits of this data stream are then interleaved (12) across a plurality of orthogonal frequency division multiplexed (OFDM) transmitters (25, 26)[3] that each transmit a plurality of radio frequency subcarriers (27).[4] By one approach these transmitters can each transmit a plurality of subcarriers at frequencies that are substantially identical as between such transmitters.[5]

2 Specification at page 4, lines 17-20.
3 Specification at page 3, lines 28-29.
4 Specification at page 5, lines 1-8.
5 Specification at page 3, line 29-page 4, line 13.

The aforementioned interleaved bits are interleaved such that adjacent datastream bits are assigned to differing transmitters and differing subcarriers (with an illustrative example in this regard being provided in FIG. 7 which is reproduced below).[6] As an illustrative example in this regard, it can be seen in FIG. 7 that two adjacent data stream (71) bits "A" and "B" are ultimately assigned such that neither shares a same transmitter or subcarrier. In particular, as illustrated, bit "A" is assigned to subcarrier 1 of transmitter 1 while bit "B" is assigned to subcarrier N on transmitter 2. "By interleaving the datastream components to effect minimal component proximity correlation as compared to the original order of the datastream *in this way*, data throughput becomes quite robust and significantly resistant to numerous kinds of channel disruptions."[7]

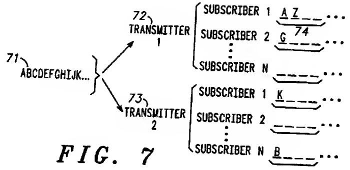


FIG. 7

These interleaved bits are then transmitted (15) using this plurality of radio frequency subcarriers of the plurality of OFDM radio frequency transmitters.[8]

(6) Grounds of Rejection to be Reviewed on Appeal

Claims 1, 12, and 17 are rejected under 35 U.S.C. 102(e) given Zhuang et al. (U.S. Patent Application No. 2003/0112745) ("Zhuang"). Claims 1, 12, 17, and 19 are rejected under 35 U.S.C. 102(e) given Ling et al. (U.S. Patent No. 6,771,706) ("Ling"). Claims 2-8, 10, 11, 13-16,

6 Specification at page 8, lines 5-page 9, line 9.
7 Specification at page 9, lines 5-9; emphasis supplied.
8 Specification at page 4, lines 8-14.

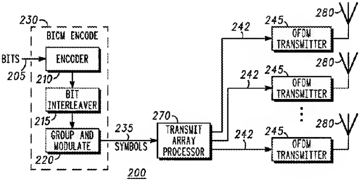
and 18 are rejected under 35 U.S.C. 103(a) given Ling in view of Sarraf et al. (U.S. Patent No. 6,747,948) ("Sarraf"). The applicant disputes these rejections.

(7) Argument

Rejections under 35 U.S.C. 102(b)

Claims 1, 12, and 17 are rejected under 35 U.S.C. 102(e) given Zhuang

Zhuang discloses a coded OFDM communication system. FIG. 2 from Zhuang is reproduced below.



As stated by Zhuang:

> The transmitter 200 may be designed to utilize the frequency diversity provided by the variation of a frequency response within a typical broadband channel. When orthogonal frequency division multiplexing (OFDM) is used by the transmitter 200, such diversity may be exploited by using appropriate coding and *interleaving across the frequency dimension*. Since OFDM is a technique that may be designed to facilitate the compensation of a frequency-selective high delay spread channel, one embodiment of the design of the transmitter 200 may be targeted to this type of channel, although the design may also be robust to flat channels.[9]
>
> . . . .
>
> Another embodiment of the invention may allow for the design of the spatial dimension of the transmitted signal *to be separated from the design in the frequency dimension*. The transmit array processor 270 processes the symbols 235 and may compute a plurality of array-processed symbols 242 that can be fed to a plurality of OFDM transmission units 245. Each output of an OFDM transmission unit may be connected to a transmit antenna 280. One embodiment of the invention may allow the transmit array processor 270 to

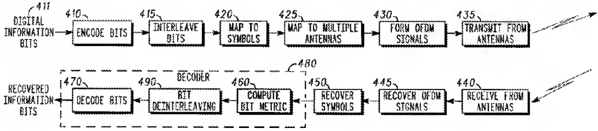
9 Zhuang at paragraph 13, emphasis provided.

> exploit any spatial diversity that may be present in the multipath channel. Transmit array processing (which may include transmit diversity techniques, space-time coding processing, or transmit array beamforming, or other related antenna array transmission techniques) occurs at the symbol level and may be performed for each subcarrier 270 in OFDM. The spatial dimension design may exploit the spatial diversity as much as possible. Depending on the number of transmit antennas 280, there are several schemes that can be performed by the transmit array processor 270 for achieving the optimal exploitation of the transmit spatial diversity.
>
> Defining M.sub.T as the number of transmit antennas and M.sub.R the number of receive antennas, there exists an elegant scheme that achieves optimal spatial diversity combining at a "full" symbol rate (i.e., one symbol per channel use) for M.sub.T=2 and M.sub.R.gtoreq.1. The scheme is an orthogonal space-time block code referred to as the Alamouti scheme after the inventor. The Alamouti scheme can be used in the context of flat channels, which may be the case on a particular OFDM sub-channel. *For every two adjacent OFDM symbols (bauds), the Alamouti scheme can be implemented straightforwardly as such:*
>
> *"during the k.sup.th baud, the first and second antennas send BICM-encoded symbol sequence s(k) and s(k+1) on a set of subcarriers, while the two antennas send -s*(k+1) and s*(k) during the (k+1).sup.th baud, respectively, where the notation (.multidot.)* denotes the conjugation of each component."*[10]

Accordingly, it is clear that a same two symbols are sent from two different antennas using two different bauds (specified here as s(k) and s(k+1)).

10 Zhuang at paragraphs 20-22, emphasis provided.

FIG. 4 from Zhuang (reproduced below) and its corresponding text provides further elaboration in this regard.



> Illustrated in FIG. 4 is a flowchart diagram for one embodiment of a method of communication 400 between the transmitting unit 200 and the receiving unit 300. The boxes 415, 420, 425, 450, 460, and 490 represent operations previously described in the detailed description of the invention. After encoding 410 the digital information bits 411, the encoded bits may be interleaved 415. In one embodiment of the invention, *the interleaver may be designed such that, for any block of length-d.sub.free bits within the encoded bit sequence, each bit of that block is eventually transmitted from a different subcarrier* [with no mention of *different* antennas being used in this regard]. An additional embodiment of the invention may provide that these different subcarriers are chosen so that the channel responses between the transmitter and the receiver on those subcarriers are minimally correlated to each other.
>
> Consecutive blocks of interleaved bits may next be mapped to transmission symbols 420. Each symbol may be transmitted on a certain OFDM subcarrier 430 from a certain antenna 435. *The step of mapping to a plurality of antennas 425 may be performed as an orthogonal space-time block code, which includes the methods previously described for FIG. 2. Additionally, the transmit weighting may be based on channel estimates (transmit beamforming or maximal ratio transmission).*[11]

In essence, then, it is clear that Zhuang's interleaving is applied *only* across multiple subcarriers in the frequency domain. Though Zhuang makes use of multiple transmitters and antennas, and though each transmitter has multiple subcarriers, Zhuang makes no teaching or suggestion that bit interleaving be applied *across these multiple antennas*. Instead, bit interleaving occurs across the subcarriers of a given transmitter, with each transmitter then using identical code bit and symbol sequences.

11 Zhuang at paragraphs 0036 and 0037, emphasis provided.

This, of course, differs considerably from the teachings of the present application. In the present application data bits are interleaved in such a manner as to assure that *adjacent* bits are assigned to *differing transmitters **and** subchannels*. Clearly, then, Zhuang does not and can not serve to anticipate such a requirement.

This limitation is present in each of independent claims 1, 12, and 17. Representative portions in this regard for each of these claims appears as follows:

Claim 1

"[I]nterleaving the bits of the datastream across a plurality of orthogonal frequency division multiplexed radio frequency transmitters, wherein each of the radio frequency transmitters transmits a plurality of radio frequency subcarriers, to provide interleaved bits wherein adjacent datastream bits are assigned to differing transmitters and differing subcarriers."

Claim 12

"[S]uch that information comprising the encoded bits datastream are interleaved across the multiple subcarriers of the first and second orthogonal frequency division multiplexed transmitters with adjacent datastream output bits being assigned to different ones of the transmitters and to different subcarriers."

Claim 17

"[I]nterleaving the sequential bits across the plurality of subcarriers for both the first and second orthogonal frequency division multiplexed transmitters with adjacent sequential bits being assigned to differing ones of the transmitters and differing ones of the subcarriers."

As Zhuang contains no teaching regarding the interleaving of such bits over multiple transmitters and multiple subcarriers, and as this limitation is plainly required by each of claims 1, 12, and 17, Zhuang cannot be said to anticipate these claims.

Claims 1, 12, and 17 are rejected under 35 U.S.C. 102(e) given Ling

Ling discloses an approach to using channel state information in a wireless communication system. Ling provides the following relevant description with respect to his FIG. 1 (reproduced below):

> System 100 includes a first system 110 in communication with a second system 150. System 100 can be operated to employ a combination of antenna, frequency, and temporal diversity (described below) to increase spectral efficiency, improve performance, and enhance flexibility. In an aspect, system 150 can be operated to determine the characteristics of the communication link and to report channel state information (CSI) back to system 110, and system 110 can be operated to adjust the processing (e.g., encoding and modulation) of data to be transmitted based on the reported CSI.
>
> Within system 110, a data source 112 provides data (i.e., information bits) to a transmit (TX) data processor 114, which encodes the data in accordance with a particular encoding scheme, interleaves (i.e., reorders) the encoded data based on a particular interleaving scheme, and maps the interleaved bits into modulation symbols for one or more transmission channels used for transmitting the data. The encoding increases the reliability of the data transmission. The interleaving provides time diversity for the coded bits, permits the data to be transmitted based on an average signal-to-noise-plus-interference (SNR) for the transmission channels used for the data transmission, combats fading, and further removes correlation between coded bits used to form each modulation symbol. The interleaving may further provide frequency diversity if the coded bits are transmitted over multiple frequency subchannels. In accordance with an aspect of the invention, the encoding, interleaving, and symbol mapping (or a combination thereof) are performed based on the full or partial CSI available to system 110, as indicated in FIG. 1.
>
> . . .

> MIMO system 100 employs multiple antennas at both the transmit and receive ends of the communication link. These transmit and receive antennas may be used to provide various forms of spatial diversity, including transmit diversity and receive diversity. Spatial diversity is characterized by the use of multiple transmit antennas and one or more receive antennas. Transmit diversity is characterized by the transmission of data over multiple transmit antennas. Typically, additional processing is performed on the data transmitted from the transmit antennas to achieved the desired diversity. For example, the data transmitted from different transmit antennas may be delayed or reordered in time, coded and interleaved across the available transmit antennas, and so on.[12]

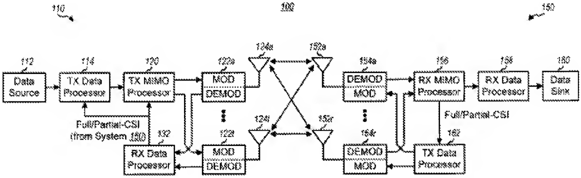


FIG. 1

Ling therefore provides some suggestion regarding the application of interleaving of bits as assigned to multiple transmitters. Ling, however, is silent with respect to the notion of interleaving his data bits in such a manner as to assure that *adjacent* bits are assigned to *differing transmitters* ***and*** *subchannels*. It is only in the applicant's teachings where such a suggestion can be found. Clearly, then, Ling does not and can not serve to anticipate such a requirement.

This limitation is present in each of independent claims 1, 12, and 17. Representative portions in this regard for each of these claims appears as follows:

Claim 1

"[I]nterleaving the bits of the datastream across a plurality of orthogonal frequency division multiplexed radio frequency transmitters, wherein each of the radio frequency transmitters transmits a plurality of radio frequency subcarriers, to provide interleaved bits wherein adjacent datastream bits are assigned to differing transmitters and differing subcarriers."

12 Ling column 3, line 21-60.

Claim 12

"[S]uch that information comprising the encoded bits datastream are interleaved across the multiple subcarriers of the first and second orthogonal frequency division multiplexed transmitters with adjacent datastream output bits being assigned to different ones of the transmitters and to different subcarriers."

Claim 17

"[I]nterleaving the sequential bits across the plurality of subcarriers for both the first and second orthogonal frequency division multiplexed transmitters with adjacent sequential bits being assigned to differing ones of the transmitters and differing ones of the subcarriers."

As Ling contains no teaching regarding the interleaving of such bits over multiple transmitters and multiple subcarriers, and as this limitation is plainly required by each of claims 1, 12, and 17, Ling cannot be said to anticipate these claims.

Rejections under 35 U.S.C. 103(a)

Claims 2-8, 10, 11, 13-16, and 18 are rejected under 35 U.S.C. 103(a) given Ling in view of Sarraf

These claims are ultimately dependent upon one of the independent claims discussed above. While the applicant believes that other arguments are available to highlight the allowable subject matter presented in various of these dependent claims, the applicant also believes that the comments set forth herein regarding allowability of the independent claims are sufficiently compelling to warrant present exclusion of such additional points for the sake of brevity.

(8) Claims Appendix

1. A method of transmitting data comprising:

- providing a datastream comprised of bits;
- interleaving the bits of the datastream across a plurality of orthogonal frequency division multiplexed radio frequency transmitters, wherein each of the radio frequency transmitters transmits a plurality of radio frequency subcarriers, to provide interleaved bits wherein adjacent datastream bits are assigned to differing transmitters and differing subcarriers;
- transmitting data that corresponds to the interleaved bits using the plurality of radio frequency subcarriers of the plurality of orthogonal frequency division multiplexed radio frequency transmitters.

2. The method of claim 1 wherein providing a datastream comprised of bits includes providing a datastream comprised of bits as provided from a single source.

3. The method of claim 1 wherein providing a datastream comprised of bits includes providing a datastream comprised of bits as provided from a plurality of sources.

4. The method of claim 3 wherein providing a datastream comprised of bits as provided from a plurality of sources includes providing a datastream comprised of bits as provided from a plurality of sources wherein at least some of the bits as provided from at least one of the plurality of sources are encoded bits.

5. The method of claim 1 wherein providing a datastream comprised of bits includes providing a datastream comprised of encoded bits.

6. The method of claim 5 wherein providing a datastream comprised of encoded bits includes providing a datastream comprised of convolutionally encoded bits.

7. The method of claim 5 wherein providing a datastream comprised of encoded bits includes providing a datastream comprised of serially concatenated convolutionally encoded bits.

8. The method of claim 5 wherein providing a datastream comprised of encoded bits includes providing a datastream comprised of parallel concatenated convolutionally encoded bits.

9. (Cancelled)

10. The method of claim 1 wherein assigning adjacent datastream bits to differing transmitters and differing subcarriers comprises assigning adjacent datastream bits to differing transmitters and differing subcarriers with low channel response correlation to thereby exploit an increased amount of spatial and frequency diversity.

11. The method of claim 10 wherein assigning adjacent datastream bits to differing transmitters and differing subcarriers with low channel resonse correlation further comprises assigning adjacent datastream bits out of each encoder when multiple encoders are used to differing transmitters and different subcarriers with low channel response correlation to thereby exploit an increased amount of spatial and frequency diversity for each encoded datastream.

12. An apparatus for transmitting data comprising:

- an encoder having a single datastream input and an encoded bits datastream output;
- a multiple-input multiple-output modulator having an input operably coupled to the encoded bits datastream output of the encoder and having a serial-to-parallel output that provides first and second items of modulation information that correspond to the encoded bits;
- a first orthogonal frequency division multiplexed transmitter having:
  - an input operably coupled to a first output of the serial-to-parallel output of the multiple-input multiple-output modulator to receive the first items of modulation information; and
  - a multiple subcarrier radio frequency transmission output; and
- a second orthogonal frequency division multiplexed transmitter having:
  - an input operably coupled to a second output of the serial-to-parallel output of the multiple-input multiple-output modulator to receive the second items of modulation information; and
  - a multiple subcarrier radio frequency transmission output;

such that information comprising the encoded bits datastream are interleaved across the multiple subcarriers of the first and second orthogonal frequency division multiplexed transmitters with adjacent datastream output bits being assigned to different ones of the transmitters and to different ones of the subcarriers.

13. The apparatus of claim 12 wherein the encoder comprises a serially concatenated convolutional encoder.

14. The apparatus of claim 12 wherein the encoder comprises a parallel concatenated convolutional encoder.

15. The apparatus of claim 12 wherein the encoder comprises a convolutional encoder.

16. The apparatus of claim 12 wherein the first and second items of modulation information that correspond to the encoded bits comprise symbols wherein each symbol represents a plurality of encoded bits.

17. A method comprising:
- providing a first and second orthogonal frequency division multiplexed transmitter wherein each transmitter transmits a plurality of subcarriers at frequencies that are substantially identical as between the first and second transmitter;
- providing a single stream of data comprised of sequential bits;
- interleaving the sequential bits across the plurality of subcarriers for both the first and second orthogonal frequency division multiplexed transmitters with adjacent sequential bits being assigned to differing ones of the transmitters and differing ones of the subcarriers.

18. The method of claim 17 wherein interleaving the sequential bits across the plurality of subcarriers for both the first and second orthogonal frequency division multiplexed transmitters with adjacent sequential bits being assigned to differing ones of the transmitters and differing ones of the subcarriers includes interleaving the sequential bits across the plurality of subcarriers for both the first and second orthogonal frequency division multiplexed transmitters with adjacent sequential bits being assigned to differing ones of the transmitters and differing ones of the subcarriers such that consecutive encoded bits of each datastream will be transmitted from transmitters and subcarriers with substantially minimal correlation.

19. (Allowed)

20. (Cancelled)

21. (Cancelled)

22. (Allowed)

24 - 27. (Cancelled)

28 - 29. (Allowed)

(9) Evidence Appendix

Not applicable.

(10) Related Proceeding Appendix

Not applicable.

Respectfully submitted,

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